ROTATION CONTROL SYSTEM FOR OPTICAL DISK

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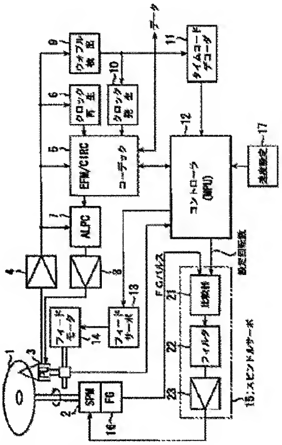
Abstract of **JP2002230887**

PROBLEM TO BE SOLVED: To make the access at any line speed possible, thereby making it possible to exhibit the performance of a system to the maximum extent.

SOLUTION: The access position in the radial direction of an optical disk 1 is detected by a time code decoder 11. A controller 12 calculates the number of revolutions of the optical disk 1 at which the line speed of the optical disk 1 attains a target line speed in this access position and sets the pulse width of the FG pulse corresponding to this number of revolutions in a comparator 21 of a spindle servo circuit 15. The comparator 21 compares the pulse width of the FG pulse set from a frequency generator 16 and the pulse width of the FG pulse set from the controller 12 and outputs the error signal thereof. This error signal subjects a spindle motor to CAV control through a filter 22 and an SPM driver 23.



CLAIMS

[Claim(s)]
[Claim 1]A roll control method of an optical disc characterized by comprising the following.
A rotational driving means which rotates an optical disc which should be accessed.
A speed setting means which sets up linear velocity used as a target at the time of accessing said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in an access position of a radial direction of said optical disc.
A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[Claim 2]A roll control method of an optical disc characterized by comprising the following.
A rotational driving means which rotates an optical disc which should record data by a constant linear velocity.
A speed setting means which sets up linear velocity used as a target at the time of recording data on said optical disc.
A radius position detection means to detect a recording position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a recording position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[Claim 3]A roll control method of an optical disc characterized by comprising the following.
A rotational driving means which rotates an optical disc in which data was recorded by a constant linear velocity.
A speed setting means which sets up linear velocity which serves as a target at the time of playing data from said optical disc.
A radius position detection means to detect a playback position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a playback position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[Claim 4]A roll control method of an optical disc of claim 1-3 characterized by what it is [a thing] characterized by comprising the following given in any 1 paragraph.
Said rotational frequency detection means is a frequency generator which detects a rotational frequency of said rotational driving means, and outputs a frequency pulse signal of width according to a rotational frequency, and said calculating means, A comparator which pulse width of a frequency pulse equivalent to said set rotating speed is computed, and said servo means measures pulse width of said frequency pulse signal, compares this pulse width with pulse width equivalent to set rotating speed from said calculating means, and outputs both deviation.
A filter which filters an output of this comparator.

A driver which drives said rotational driving means with the output of this filter.

[Claim 5]A limit according [said speed setting means] to quality of said optical disc, A roll control method of an optical disc of claim 1-4 being able to set up the highest access speed magnification defined by at least one of the limits by system environment, such as a limit of a laser diode output, and a data transfer rate, as linear velocity used as a target given in any 1 paragraph.

[Claim 6]A roll control method of the optical disc according to claim 2 or 3, wherein said radius position detection means is what detects an access position of a radial direction of said optical disc from a hour entry read in said optical disc.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the roll control method of the optical disc for accessing especially an optical disc with arbitrary linear velocity about the optical-disk-recording playback equipment which records information and is played to optical discs, such as CD-R, CD-RW, CD-WO, MD, and DVD.
[0002]
[Description of the Prior Art]Generally, in order that the data recording system to CD or MD may raise data storage capacity, the recording method by CLV (constant linear velocity) control is adopted. Therefore, it is necessary to change the revolving speed of CD according to the access position of the head to CD at the time of playback of data. Drawing 9 is a figure for explaining the roll control method of the optical disc in the conventional CLV. The read-out data read from the optical disc 101 rotated with the spindle motor (SPM) 102 via the optical pickup 103 is supplied to the clock reproduction machine 104, and clock signal CK is played here. Reproduction clock signal CK is supplied to one comparison input end of the phase comparator 105. On the other hand, as for N dividing, reference clock CK0 generated with the reference clock generation machine 106 is carried out with the counting-down circuit 107, and it is supplied to the comparison input end of another side of the phase comparator 105. In the phase comparator 105, the phase comparison of the reference clock CKn which was set to reproduction clock signal CK as for N dividing is carried out, the phase difference output PC is fed back to the spindle motor 102 via the filter 108 and the SPM driver 109, and the roll control of the spindle motor 102 is carried out.
[0003]According to this method, since the frequency of the reference clock CKn is constant, it requires a spindle servo irrespective of the access position over the optical disc 101 so that the frequency (playback data rate) of reproduction clock signal CK may serve as constant value always equal to the reference clock signal CKn. For this reason, by the high velocity revolution and periphery side, CLV control is carried out and the optical disc 101 is driven at the inner circumference side so that it may become a low speed rotary.
[0004]
[Problem(s) to be Solved by the Invention]By the way, such record and reproduction speed of optical-disk-recording playback equipment are determined by the frequency of reference clock signal DK0, and the division ratio of the counting-down circuit 107. In the case of 2 dividing system clock, the record and reproduction speed which can be set up are restricted to 1X, 2X, 4X, 8X, 16X, and —. Although the device which performs a division ratio change is also known combining the low clock of a 2 dividing system, and the high clock of a 3 dividing system, speed setting, such as 3X, 6X, 12X, and —, is added in this case.
[0005]However, in the roll control method of the optical disc mentioned above. For example, when the maximum output and reproduction speed to an optical disc are restricted, the quickest speed cannot be chosen from the limit by system environment, such as a limit by the maximum power of laser, a limit by medium quality, and a transfer rate, etc. in the range of a limiting speed. Drawing 10 showed this. Supposing the maximum output and playback linear velocity to an optical disc are 11.5X now, even if it will combine 2 dividing system clock and 3 dividing system clock, only 8X can be chosen as top speed. For this reason, although record and reproduction were possible for the field from 8X to 11.5X, it had turned into a field which cannot be used.
[0006]This invention was made in order to solve such a problem, and it enables access with arbitrary linear velocity, and an object of an invention is to provide the roll control method of the optical disc which can demonstrate the performance of a system by this to the maximum extent.
[0007]
[Means for Solving the Problem]This invention is characterized by a roll control method of the 1st optical disc comprising the following.
A rotational driving means which rotates an optical disc which should be accessed.

A speed setting means which sets up linear velocity used as a target at the time of accessing said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in an access position of a radial direction of said optical disc.
A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0008]This invention is characterized by a roll control method of the 2nd optical disc comprising the following.
A rotational driving means which rotates an optical disc which should record data by a constant linear velocity.
A speed setting means which sets up linear velocity used as a target at the time of recording data on said optical disc.
A radius position detection means to detect a recording position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a recording position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0009]This invention is characterized by a roll control method of the 3rd optical disc comprising the following.
A rotational driving means which rotates an optical disc in which data was recorded by a constant linear velocity.
A speed setting means which sets up linear velocity which serves as a target at the time of playing data from said optical disc.
A radius position detection means to detect a playback position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a playback position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0010]According to this invention, linear velocity of an optical disc makes number of rotations of an optical disc used as linear velocity set up beforehand set rotating speed in an access position of a radial direction of an optical disc which was detected by a radius position detection means, or was predicted, and it computes by a calculating means. Since it is made to carry out drive controlling of the rotational driving means so that this computed set rotating speed may be compared with actual number of rotations of an optical disc and actual number of rotations may be in agreement with set rotating speed, A desired value of linear velocity is not determined by frequency of a basic clock signal, and division ratio of a counting-down circuit like before, and it becomes possible to set up arbitrary linear velocity as a desired value. Access of an optical disc in maximum output and playback linear velocity with which performance which a system has is demonstrated by this to the maximum extent is also attained.
[0011]Said rotational frequency detection means can be used as a frequency generator which detects a rotational frequency of a rotational driving means, for example, and outputs a frequency pulse signal of width according to a rotational frequency, A calculating means computes pulse width of a frequency pulse which is equivalent to said set rotating speed, for example, and said servo means, For example, measure pulse width of a frequency pulse signal and this pulse width is compared with pulse width equivalent to set rotating speed from a calculating means, A comparator which outputs both deviation, a filter which filters an output of this comparator, and a driver which drives a rotational driving means with the output of this filter can be had and constituted.
[0012]A radius position detection means can be constituted so that an access position of said optical disc may be detected from a hour entry read in an optical disc, for example. In this case, since read-out of a hour entry becomes intermittent, CAV (number-of-rotations regularity) control is performed to a start of a roll control by set rotating speed computed by the following hour entry from a start of a roll control by set rotating speed computed by one hour entry. For this reason, if a curve of linear velocity to a radial direction position of an optical disc is seen microscopically, it will become stair-like and a roll control will turn into false CLV control, but such false CLV control is also widely included under the category of CLV control, and is dealt with here.

[0013]
[Embodiment of the Invention]Hereafter, the desirable embodiment of this invention is described with reference to drawings. Drawing 1 is a block diagram showing the composition of the important section of the optical-disk-recording playback equipment concerning the desirable embodiment of this invention. For example record reproduction, such as CD-R, CD-RW, CD-WO, MD, and DVD, is possible, and data is recorded with CLV, or the optical disc 1 is recorded. The data which this optical disc 1 was rotated with the spindle motor (SPM) 2 which is a rotational driving means, and data was recorded by the optical pickup 3 by which the placed opposite was carried out, or was recorded is read. The data of the RF signal gestalt read from the optical pickup 3, After being amplified by the read-out driver 4, the EFM/CIRC (Eight to Fourteen Modulation/Cross Interleaved Reed-Solomon Code) codec 5 is supplied, and EFM-get over and CIRC decoding processing is carried out, It becomes digital data and is outputted to an external device. The output of the read-out driver 4 is supplied also to the clock reproduction machine 6, and a reading clock signal is reproduced here and it is supplied as a reference clock of an EFM/CIRC codec. On the other hand, the data which is supplied from an external device and which should be recorded, By the EFM/CIRC codec 5, CIRC coding processing, subcode-data addition, After becoming record data through processing of eight-to-fourteen modulation etc., the ALPC (Automatic Laser PowerControl) circuit 7 is supplied, it becomes the record signal by which laser power adjustment was carried out, and the optical pickup 3 is supplied via the record driver 8. The optical pickup 3 forms a record pit on the optical disc 1 by the write-in power of laser. In the case of record, ALPC circuit 7 monitors the catoptric light from the optical disc 1 via the read-out driver 4, and laser power is controlled. It is detected by the wobble detector 9, the clock generation machine 10 generates a recording clock from the wobble signal outputted from this wobble detector 9, and the wobble formed in the optical disc 1 supplies it to the EFM/CIRC codec 5. The wobble signal from the wobble detector 9 is supplied also to the time code decoder 11, and the ATIP (Absolute Time In Pregroove) time code which is the absolute time information included in a wobble signal here is detected. This ATIP time code also shows the access position of the radial direction of the optical disc 1, and this is supplied to the controller 12.
[0014]The controller (MPU) 12 controls the feed motor 14 via the feeding servo circuit 13, and determines the position to the optical disc radial direction of the optical pickup 3. The controller 12 performs the roll control of the spindle motor 2 via the spindle servo circuit 15. The frequency generator (FG) 16 which outputs FG pulse of the pulse width according to that number of rotations is formed in the spindle motor 2, and FG pulse from this frequency generator 16 is supplied to the spindle servo circuit 15. The linear velocity used as the target in the case of access to the optical disc 1 is set as the controller 12 with the speed setter 17. The controller 12 computes the present access position of the radial direction of the optical disc 1 from the ATIP time code decoded by the time code decoder 11, and, The linear velocity of the optical disc 1 computes the number of rotations of the optical disc 1 used as the intended line speed set up with the speed setter 17 in the computed access position, It is set as the spindle servo circuit 15 by making into set rotating speed the information which shows the pulse width of FG pulse which should be acquired when rotating the spindle motor 2 at this number of rotations.
[0015]The spindle servo circuit 15 is constituted by the comparator 21, the filter 22, and the SPG driver 23. The comparator 21 compares the set rotating speed (FG pulse width) from the controller 12 with FG pulse from the frequency generator 17, and carries out the roll control of the spindle motor 2 by feeding back the error to the spindle motor 2 via the filter 22 and the SPM driver 23.
[0016]The reference clock generation machine 31 with which the comparator 21 generates the reference clock signal CKr as shown, for example in drawing 2, The gate circuit 32 which carries out the gate of the reference clock CKr by FG pulse, and the counter 33 which counts the output of this gate circuit 32, The RS-flip-flop circuit 34 which is set in the standup of FG pulse, is reset in the standup of the reference clock signal CKr, and resets the counted value of the counter 33, It has the subtractor 35 which outputs the difference of the counted value of the counter 33, and the set rotating speed from the controller 12 as an error, and is constituted. The comparator 1 measures the pulse number of the reference pulse signal CKr settled in the pulse width of FG pulse from the frequency generator 17 by such composition as shown in drawing 3 at the counter 33, Both error signal is outputted as compared with the pulse number corresponding to the set rotating speed set up from the controller 12.
[0017]Next, roll control operation of the optical disc at the time of record of the optical-disk-recording playback equipment constituted in this way is explained. Drawing 4 is a figure showing the relation between the access (record) position of the radial direction of the optical disc 1 in this example, number of rotations, and linear velocity. The roll control of the optical disc in this embodiment is Partial CAV control, and CAV control by which the number of rotations of the spindle motor 2 is set as the several Nm controllable maximum rotation is performed in the inner circumference side of the optical disc 1 in which record is started. Linear velocity serves

as false CLV control in the position of a periphery rather than the access position rm which reaches target speed or the critical speed Vm.

[0018]Drawing 5 is a flow chart which shows processing of the controller 12. Supposing record is started from the most inner circumference of the program area of the optical disc 1, the controller 12 will set the number of pulse counts equivalent to the several Nm rotation as the comparator 21 first that the number of rotations of the spindle motor 2 should be set as the several Nm rotation at the time of a rotation start (S1). The Hall device built in the frequency generator 16 formed in the spindle motor 2 as a detector generates the FG pulse signal of the width corresponding to the rotational frequency of the spindle motor 2. The comparator 21 measures the pulse number of the reference pulse signal CKr settled in FG pulse width received from the frequency generator 16, and outputs the error as compared with the pulse number set up from the controller 12. An error signal is supplied to the spindle motor 2 via the filter 22 and the SPM driver 23, and controls the number of rotations of the spindle motor 2. If it becomes several Nm desired rotation, the CAV control loop of the spindle servo 15 will close.

[0019]If CAV control of the optical disc 1 of CLV is carried out, as shown in drawing 4 (b), linear velocity will increase as it moves to the periphery side from the inner circumference side. It is equivalent to the increase in linear velocity becoming speed recording, and the more it becomes speed recording, the more recording laser power is needed. However, since it leads to LD destruction when there is a limit in the output of a laser diode (LD) and a limit is exceeded, exceeding is not desirable. Therefore, maximum output speed has leveling off. In addition, maximum output speed is restricted by system environment, such as disk quality and a data transfer rate, etc.

[0020]The optical pickup 3 reads the ATIP time code on the optical disc 1, recording. This time code is decoded by the time code decoder 11. As this time code, a pre pit, a fine clock mark, etc. other than a wobble signal can be used. As these time codes are shown in drawing 6, it defines per frame, and when a frame is read, an ATIP time code is decoded by the time code decoder 11. The ATIP time code supports the radius position on the optical disc 1, and the optical disc number of rotations corresponding to that code position can be calculated from this time code.

[0021]If record is started by a CAV roll control, the target speed soon set up with the speed setter 17 will be reached. When maximum velocity is set up especially as target speed, the critical speed Vm is reached. Although the following explanation explains the case where target speed is set as the critical speed Vm, it cannot be overemphasized that it becomes the operation same also in the case of other arbitrary target speed. The time code of the radius position rm which reaches the critical speed Vm shown in drawing 4 (b) is calculated by the controller 12 from the restricted maximum output linear velocity, the orienting line speed of the optical disc 1, and a track pitch (S2). The controller 12 supervises an ATIP time code (S3), if it detects that the optical pickup 3 arrived at the limit position, it will change (S4) and the pulse number set up till then for CAV control, and it shifts to the false CLV control by the critical speed Vm.

[0022]In this false CLV control, the controller 12 computes the number of rotations at the time of performing critical speed CLV control in that radius position from the read ATIP time code (S6), and the number of pulse counts equivalent to that number of rotations is set as the comparator 21 (S7). If it passes over one frame, the following ATIP time code will be read (S5). The controller 12 computes the number of rotations at the time of performing critical speed CLV control in the radius position of the optical disc 1 which is equivalent to the ATIP time code similarly (S6), and the number of pulse counts equivalent to the number of rotations is set as the comparator 21 (S7). Henceforth, whenever one ATIP time code progresses, the controller 12 sets the pulse number corresponding to number of rotations as the comparator 21 (S5-S6), and controls the spindle motor 2 to become the number of rotations. Thereby very fine CAV recording operation can be connected continuously, and a false CLV control record can be performed.

[0023]By performing the above control, as shown in drawing 7, access in the field of the linear velocity which was not able to be used conventionally is attained, and it becomes possible to demonstrate the maximum capacity of a system.

[0024]Drawing 8 is a figure for explaining the roll control method of the optical disc concerning other embodiments of this invention. Also in this embodiment, since the composition of optical-disk-recording playback equipment itself is the same as that of drawing 1, it omits explanation about the composition of a device. Although the controller 12 set up the number of pulse counts corresponding to that radius position from the read ATIP time code in the previous embodiment, the critical speed Vm will be slightly exceeded at the end time of access of one frame in this case. So, in this example, the controller 12 will set the number of pulse counts equivalent to the number of rotations at the time of performing critical speed CLV control in the radius position of the ATIP time code of the following frame as the comparator 21, if an ATIP time code is read.

[0025]Since according to this example it is at the end time of access of one frame and linear velocity reaches

the critical speed Vm, linear velocity does not exceed the critical speed Vm.
[0026]This invention is not limited to the embodiment mentioned above. For example, in each above-mentioned embodiment, although the roll control of the optical disc at the time of the data recording to an optical disc was explained, the same roll control is possible at the time of the data reproduction from an optical disc by which CLV record was carried out.
[0027]Although the servo was applied to the spindle motor 2 in each above-mentioned embodiment by the frequency comparison of the set rotating speed from the controller 12, and the pulse width of FG pulse from the frequency generator 16 for CAV control, A phase error is searched for and it may be made to apply a servo to the spindle motor 2 based on this phase error by the phase comparison of FG pulse used as the desired value generated by the controller 12, and actual FG pulse. If frequency is compared with both phase and an error signal is acquired, control precision will improve more.
[0028]Although this invention was applied to the PartialCAV method used as CAV control by the inner circumference side of the optical disc 1 at each above-mentioned embodiment, It may be made to perform false CLV control mentioned above from the beginning (most-inner-circumference side) of the program area depending on the rotational capacity of a spindle motor, or the value of intended line speed.
[0029]Although the controller 12 detected the access position of the radial direction of an optical disc in the above-mentioned embodiment based on the absolute time information of the ATIP time code decoded from the wobble signal, As long as not only address information such but accuracy is allowed, the external linear scaler which detects the position of the feed direction of an optical pickup may be used as a radius position detection means. It may be made for the controller 12 to predict the access position of an optical pickup according to record or regeneration time, for example, without basing the access position of the radial direction of an optical disc on detection. Although number of rotations was set up for every frame, it may be made to set up number of rotations every [two or more] several frames in the above-mentioned example.
[0030]
[Effect of the Invention]As stated above, according to this invention, the linear velocity of an optical disc makes the number of rotations of the optical disc used as the linear velocity set up beforehand set rotating speed in an access position, and it computes by a calculating means, Since it is made to carry out drive controlling of the rotational driving means so that this computed set rotating speed may be compared with the actual number of rotations of an optical disc and actual number of rotations may be in agreement with set rotating speed, The desired value of linear velocity is not determined by the frequency of a basic clock signal, and the division ratio of a counting-down circuit like before, and it becomes possible to set up arbitrary linear velocity as a desired value. Thereby, the performance which a system has does so the effect that access of the optical disc in the maximum output and playback linear velocity demonstrated to the maximum extent is also attained.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention]This invention relates to the roll control method of the optical disc for accessing especially an optical disc with arbitrary linear velocity about the optical-disk-recording playback equipment which records information and is played to optical discs, such as CD-R, CD-RW, CD-WO, MD, and DVD.

[Translation done.]

PRIOR ART

[Description of the Prior Art]Generally, in order that the data recording system to CD or MD may raise data storage capacity, the recording method by CLV (constant linear velocity) control is adopted. Therefore, it is necessary to change the revolving speed of CD according to the access position of the head to CD at the time of playback of data. Drawing 9 is a figure for explaining the roll control method of the optical disc in the conventional CLV. The read-out data read from the optical disc 101 rotated with the spindle motor (SPM) 102 via the optical pickup 103 is supplied to the clock reproduction machine 104, and clock signal CK is played here. Reproduction clock signal CK is supplied to one comparison input end of the phase comparator 105. On the other hand, as for N dividing, reference clock CK0 generated with the reference clock generation machine 106 is carried out with the counting-down circuit 107, and it is supplied to the comparison input end of another side of the phase comparator 105. In the phase comparator 105, the phase comparison of the reference clock CKn which was set to reproduction clock signal CK as for N dividing is carried out, the phase difference output PC is fed back to the spindle motor 102 via the filter 108 and the SPM driver 109, and the roll control of the spindle motor 102 is carried out.

[0003]According to this method, since the frequency of the reference clock CKn is constant, it requires a spindle servo irrespective of the access position over the optical disc 101 so that the frequency (playback data rate) of reproduction clock signal CK may serve as constant value always equal to the reference clock signal CKn. For this reason, by the high velocity revolution and periphery side, CLV control is carried out and the optical disc 101 is driven at the inner circumference side so that it may become a low speed rotary.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]As stated above, in this invention, the linear velocity of an optical disc makes the number of rotations of the optical disc used as the linear velocity set up beforehand set rotating speed in an access position, and it computes by a calculating means, This computed set rotating speed is compared with the actual number of rotations of an optical disc, and it is made to carry out drive controlling of the rotational driving means so that actual number of rotations may be in agreement with set rotating speed.
Therefore, the desired value of linear velocity is not determined by the frequency of a basic clock signal, and the division ratio of a counting-down circuit like before, and it becomes possible to set up arbitrary linear velocity as a desired value.
Thereby, the performance which a system has does so the effect that access of the optical disc in the maximum output and playback linear velocity demonstrated to the maximum extent is also attained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]By the way, such record and reproduction speed of optical-disk-recording playback equipment are determined by the frequency of reference clock signal DK0, and the division ratio of the counting-down circuit 107. In the case of 2 dividing system clock, the record and reproduction speed which can be set up are restricted to 1X, 2X, 4X, 8X, 16X, and —. Although the device which performs a division ratio change is also known combining the low clock of a 2 dividing system, and the high clock of a 3 dividing system, speed setting, such as 3X, 6X, 12X, and —, is added in this case.
[0005]However, in the roll control method of the optical disc mentioned above. For example, when the maximum output and reproduction speed to an optical disc are restricted, the quickest speed cannot be chosen from the limit by system environment, such as a limit by the maximum power of laser, a limit by medium quality, and a transfer rate, etc. in the range of a limiting speed. Drawing 10 showed this. Supposing the maximum output and playback linear velocity to an optical disc are 11.5X now, even if it will combine 2 dividing system clock and 3 dividing system clock, only 8X can be chosen as top speed. For this reason, although record and reproduction were possible for the field from 8X to 11.5X, it had turned into a field which cannot be used.
[0006]This invention was made in order to solve such a problem, and it enables access with arbitrary linear velocity, and an object of an invention is to provide the roll control method of the optical disc which can demonstrate the performance of a system by this to the maximum extent.

[Translation done.]

MEANS

[Means for Solving the Problem]This invention is characterized by a roll control method of the 1st optical disc comprising the following.
A rotational driving means which rotates an optical disc which should be accessed.
A speed setting means which sets up linear velocity used as a target at the time of accessing said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in an access position of a radial direction of said optical disc.
A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0008]This invention is characterized by a roll control method of the 2nd optical disc comprising the following.
A rotational driving means which rotates an optical disc which should record data by a constant linear velocity.
A speed setting means which sets up linear velocity used as a target at the time of recording data on said optical disc.
A radius position detection means to detect a recording position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a recording position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0009]This invention is characterized by a roll control method of the 3rd optical disc comprising the following.
A rotational driving means which rotates an optical disc in which data was recorded by a constant linear velocity.
A speed setting means which sets up linear velocity which serves as a target at the time of playing data from said optical disc.
A radius position detection means to detect a playback position of a radial direction of said optical disc.
A calculating means in which linear velocity of said optical disc computes number of rotations of said optical disc used as linear velocity set up by said speed setting means as set rotating speed in a playback position of a radial direction of an optical disc detected by this radius position detection means, A rotational frequency detection means which detects actual number of rotations of said optical disc, and a servo means which carries out drive controlling of said rotational driving means so that actual number of rotations detected by said rotational frequency detection means may turn into number of rotations computed by said calculating means.

[0010]According to this invention, linear velocity of an optical disc makes number of rotations of an optical disc used as linear velocity set up beforehand set rotating speed in an access position of a radial direction of an optical disc which was detected by a radius position detection means, or was predicted, and it computes by a calculating means, Since it is made to carry out drive controlling of the rotational driving means so that this computed set rotating speed may be compared with actual number of rotations of an optical disc and actual number of rotations may be in agreement with set rotating speed, A desired value of linear velocity is not determined by frequency of a basic clock signal, and division ratio of a counting-down circuit like before, and it becomes possible to set up arbitrary linear velocity as a desired value. Access of an optical disc in maximum output and playback linear velocity with which performance which a system has is demonstrated by this to the

maximum extent is also attained.
[0011]Said rotational frequency detection means can be used as a frequency generator which detects a rotational frequency of a rotational driving means, for example, and outputs a frequency pulse signal of width according to a rotational frequency, A calculating means computes pulse width of a frequency pulse which is equivalent to said set rotating speed, for example, and said servo means, For example, measure pulse width of a frequency pulse signal and this pulse width is compared with pulse width equivalent to set rotating speed from a calculating means, A comparator which outputs both deviation, a filter which filters an output of this comparator, and a driver which drives a rotational driving means with the output of this filter can be had and constituted.
[0012]A radius position detection means can be constituted so that an access position of said optical disc may be detected from a hour entry read in an optical disc, for example. In this case, since read-out of a hour entry becomes intermittent, CAV (number-of-rotations regularity) control is performed to a start of a roll control by set rotating speed computed by the following hour entry from a start of a roll control by set rotating speed computed by one hour entry. For this reason, if a curve of linear velocity to a radial direction position of an optical disc is seen microscopically, it will become stair-like and a roll control will turn into false CLV control, but such false CLV control is also widely included under the category of CLV control, and is dealt with here.
[0013]
[Embodiment of the Invention]Hereafter, the desirable embodiment of this invention is described with reference to drawings. Drawing 1 is a block diagram showing the composition of the important section of the optical-disk-recording playback equipment concerning the desirable embodiment of this invention. For example record reproduction, such as CD-R, CD-RW, CD-WO, MD, and DVD, is possible, and data is recorded with CLV, or the optical disc 1 is recorded. The data which this optical disc 1 was rotated with the spindle motor (SPM) 2 which is a rotational driving means, and data was recorded by the optical pickup 3 by which the placed opposite was carried out, or was recorded is read. The data of the RF signal gestalt read from the optical pickup 3, After being amplified by the read-out driver 4, the EFM/CIRC (Eight to Fourteen Modulation/Cross Interleaved Reed-Solomon Code) codec 5 is supplied, and EFM-get over and CIRC decoding processing is carried out, It becomes digital data and is outputted to an external device. The output of the read-out driver 4 is supplied also to the clock reproduction machine 6, and a reading clock signal is reproduced here and it is supplied as a reference clock of an EFM/CIRC codec. On the other hand, the data which is supplied from an external device and which should be recorded, By the EFM/CIRC codec 5, CIRC coding processing, subcode-data addition, After becoming record data through processing of eight-to-fourteen modulation etc., the ALPC (Automatic Laser PowerControl) circuit 7 is supplied, it becomes the record signal by which laser power adjustment was carried out, and the optical pickup 3 is supplied via the record driver 8. The optical pickup 3 forms a record pit on the optical disc 1 by the write-in power of laser. In the case of record, ALPC circuit 7 monitors the catoptric light from the optical disc 1 via the read-out driver 4, and laser power is controlled. It is detected by the wobble detector 9, the clock generation machine 10 generates a recording clock from the wobble signal outputted from this wobble detector 9, and the wobble formed in the optical disc 1 supplies it to the EFM/CIRC codec 5. The wobble signal from the wobble detector 9 is supplied also to the time code decoder 11, and the ATIP (Absolute Time In Pregroove) time code which is the absolute time information included in a wobble signal here is detected. This ATIP time code also shows the access position of the radial direction of the optical disc 1, and this is supplied to the controller 12.
[0014]The controller (MPU) 12 controls the feed motor 14 via the feeding servo circuit 13, and determines the position to the optical disc radial direction of the optical pickup 3. The controller 12 performs the roll control of the spindle motor 2 via the spindle servo circuit 15. The frequency generator (FG) 16 which outputs FG pulse of the pulse width according to that number of rotations is formed in the spindle motor 2, and FG pulse from this frequency generator 16 is supplied to the spindle servo circuit 15. The linear velocity used as the target in the case of access to the optical disc 1 is set as the controller 12 with the speed setter 17. The controller 12 computes the present access position of the radial direction of the optical disc 1 from the ATIP time code decoded by the time code decoder 11, and. The linear velocity of the optical disc 1 computes the number of rotations of the optical disc 1 used as the intended line speed set up with the speed setter 17 in the computed access position, It is set as the spindle servo circuit 15 by making into set rotating speed the information which shows the pulse width of FG pulse which should be acquired when rotating the spindle motor 2 at this number of rotations.
[0015]The spindle servo circuit 15 is constituted by the comparator 21, the filter 22, and the SPG driver 23. The comparator 21 compares the set rotating speed (FG pulse width) from the controller 12 with FG pulse from the frequency generator 17, and carries out the roll control of the spindle motor 2 by feeding back the error to the spindle motor 2 via the filter 22 and the SPM driver 23.
[0016]The reference clock generation machine 31 with which the comparator 21 generates the reference clock

signal CKr as shown. for example in drawing 2. The gate circuit 32 which carries out the gate of the reference clock CKr by FG pulse, and the counter 33 which counts the output of this gate circuit 32, The RS-flip-flop circuit 34 which is set in the standup of FG pulse, is reset in the standup of the reference clock signal CKr, and resets the counted value of the counter 33, It has the subtractor 35 which outputs the difference of the counted value of the counter 33, and the set rotating speed from the controller 12 as an error, and is constituted. The comparator 1 measures the pulse number of the reference pulse signal CKr settled in the pulse width of FG pulse from the frequency generator 17 by such composition as shown in drawing 3 at the counter 33. Both error signal is outputted as compared with the pulse number corresponding to the set rotating speed set up from the controller 12.

[0017]Next, roll control operation of the optical disc at the time of record of the optical-disk-recording playback equipment constituted in this way is explained. Drawing 4 is a figure showing the relation between the access (record) position of the radial direction of the optical disc 1 in this example, number of rotations, and linear velocity. The roll control of the optical disc in this embodiment is Partial CAV control, and CAV control by which the number of rotations of the spindle motor 2 is set as the several Nm controllable maximum rotation is performed in the inner circumference side of the optical disc 1 in which record is started. Linear velocity serves as false CLV control in the position of a periphery rather than the access position rm which reaches target speed or the critical speed Vm.

[0018]Drawing 5 is a flow chart which shows processing of the controller 12. Supposing record is started from the most inner circumference of the program area of the optical disc 1, the controller 12 will set the number of pulse counts equivalent to the several Nm rotation as the comparator 21 first that the number of rotations of the spindle motor 2 should be set as the several Nm rotation at the time of a rotation start (S1). The Hall device built in the frequency generator 16 formed in the spindle motor 2 as a detector generates the FG pulse signal of the width corresponding to the rotational frequency of the spindle motor 2. The comparator 21 measures the pulse number of the reference pulse signal CKr settled in FG pulse width received from the frequency generator 16, and outputs the error as compared with the pulse number set up from the controller 12. An error signal is supplied to the spindle motor 2 via the filter 22 and the SPM driver 23, and controls the number of rotations of the spindle motor 2. If it becomes several Nm desired rotation, the CAV control loop of the spindle servo 15 will close.

[0019]If CAV control of the optical disc 1 of CLV is carried out, as shown in drawing 4 (b), linear velocity will increase as it moves to the periphery side from the inner circumference side. It is equivalent to the increase in linear velocity becoming speed recording, and the more it becomes speed recording, the more recording laser power is needed. However, since it leads to LD destruction when there is a limit in the output of a laser diode (LD) and a limit is exceeded, exceeding is not desirable. Therefore, maximum output speed has leveling off. In addition, maximum output speed is restricted by system environment, such as disk quality and a data transfer rate, etc.

[0020]The optical pickup 3 reads the ATIP time code on the optical disc 1, recording. This time code is decoded by the time code decoder 11. As this time code, a pre pit, a fine clock mark, etc. other than a wobble signal can be used. As these time codes are shown in drawing 6, it defines per frame, and when a frame is read, an ATIP time code is decoded by the time code decoder 11. The ATIP time code supports the radius position on the optical disc 1, and the optical disc number of rotations corresponding to that code position can be calculated from this time code.

[0021]If record is started by a CAV roll control, the target speed soon set up with the speed setter 17 will be reached. When maximum velocity is set up especially as target speed, the critical speed Vm is reached. Although the following explanation explains the case where target speed is set as the critical speed Vm, it cannot be overemphasized that it becomes the operation same also in the case of other arbitrary target speed. The time code of the radius position rm which reaches the critical speed Vm shown in drawing 4 (b) is calculated by the controller 12 from the restricted maximum output linear velocity, the orienting line speed of the optical disc 1, and a track pitch (S2). The controller 12 supervises an ATIP time code (S3), if it detects that the optical pickup 3 arrived at the limit position, it will change (S4) and the pulse number set up till then for CAV control, and it shifts to the false CLV control by the critical speed Vm.

[0022]In this false CLV control, the controller 12 computes the number of rotations at the time of performing critical speed CLV control in that radius position from the read ATIP time code (S6), and the number of pulse counts equivalent to that number of rotations is set as the comparator 21 (S7). If it passes over one frame, the following ATIP time code will be read (S5). The controller 12 computes the number of rotations at the time of performing critical speed CLV control in the radius position of the optical disc 1 which is equivalent to the ATIP time code similarly (S6), and the number of pulse counts equivalent to the number of rotations is set as the comparator 21 (S7). Henceforth, whenever one ATIP time code progresses, the controller 12 sets the pulse

number corresponding to number of rotations as the comparator 21 (S5-S6), and controls the spindle motor 2 to become the number of rotations. Thereby very fine CAV recording operation can be connected continuously, and a false CLV control record can be performed.

[0023]By performing the above control, as shown in drawing 7, access in the field of the linear velocity which was not able to be used conventionally is attained, and it becomes possible to demonstrate the maximum capacity of a system.

[0024]Drawing 8 is a figure for explaining the roll control method of the optical disc concerning other embodiments of this invention. Also in this embodiment, since the composition of optical-disk-recording playback equipment itself is the same as that of drawing 1, it omits explanation about the composition of a device. Although the controller 12 set up the number of pulse counts corresponding to that radius position from the read ATIP time code in the previous embodiment, the critical speed Vm will be slightly exceeded at the end time of access of one frame in this case. So, in this example, the controller 12 will set the number of pulse counts equivalent to the number of rotations at the time of performing critical speed CLV control in the radius position of the ATIP time code of the following frame as the comparator 21, if an ATIP time code is read.

[0025]Since according to this example it is at the end time of access of one frame and linear velocity reaches the critical speed Vm, linear velocity does not exceed the critical speed Vm.

[0026]This invention is not limited to the embodiment mentioned above. For example, in each above-mentioned embodiment, although the roll control of the optical disc at the time of the data recording to an optical disc was explained, the same roll control is possible at the time of the data reproduction from an optical disc by which CLV record was carried out.

[0027]Although the servo was applied to the spindle motor 2 in each above-mentioned embodiment by the frequency comparison of the set rotating speed from the controller 12, and the pulse width of FG pulse from the frequency generator 16 for CAV control, A phase error is searched for and it may be made to apply a servo to the spindle motor 2 based on this phase error by the phase comparison of FG pulse used as the desired value generated by the controller 12, and actual FG pulse. If frequency is compared with both phase and an error signal is acquired, control precision will improve more.

[0028]Although this invention was applied to the PartialCAV method used as CAV control by the inner circumference side of the optical disc 1 at each above-mentioned embodiment. It may be made to perform false CLV control mentioned above from the beginning (most-inner-circumference side) of the program area depending on the rotational capacity of a spindle motor, or the value of intended line speed.

[0029]Although the controller 12 detected the access position of the radial direction of an optical disc in the above-mentioned embodiment based on the absolute time information of the ATIP time code decoded from the wobble signal, As long as not only address information such but accuracy is allowed, the external linear scaler which detects the position of the feed direction of an optical pickup may be used as a radius position detection means. It may be made for the controller 12 to predict the access position of an optical pickup according to record or regeneration time, for example, without basing the access position of the radial direction of an optical disc on detection. Although number of rotations was set up for every frame, it may be made to set up number of rotations every [two or more] several frames in the above-mentioned example.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a block diagram showing the composition of the optical-disk-recording playback equipment concerning a 1st embodiment of this invention.
[Drawing 2]It is a block diagram showing the example of composition of the comparator in the device.
[Drawing 3]It is a figure for explaining operation of the comparator.
[Drawing 4]It is a graph which shows a relation with the radius position of an optical disc, the number of rotations, and linear velocity by a roll control by the device.
[Drawing 5]It is a flow chart which shows the processing in connection with the roll control at the time of record of the controller in the device.
[Drawing 6]It is a figure for explaining the ATIP time code of an optical disc.
[Drawing 7]It is a graph which shows the relation between the radius position of the optical disc for explaining the effect of this invention, and linear velocity.
[Drawing 8]It is a graph which shows a relation with the radius position of an optical disc, the number of rotations, and linear velocity by the roll control method of the optical disc concerning other embodiments of this invention.
[Drawing 9]It is a block diagram showing the composition of the roll control device of the conventional optical disc.

* NOTICES *

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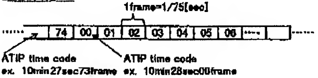
damages caused by the use of this translation.

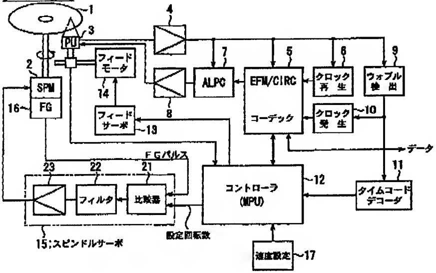
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

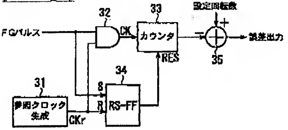
[Drawing 6]



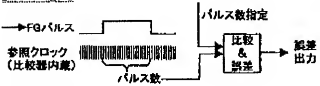
[Drawing 1]



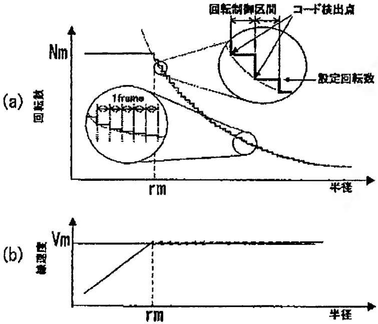
[Drawing 2]



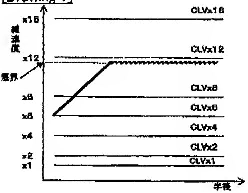
[Drawing 3]



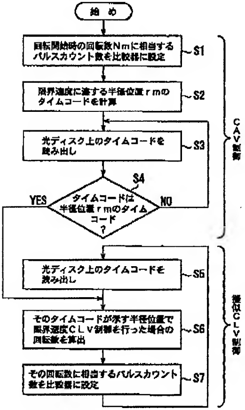
[Drawing 4]



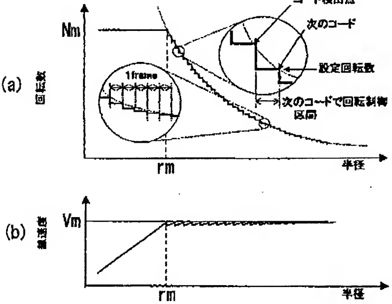
[Drawing 7]



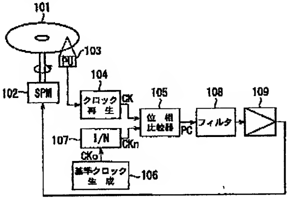
[Drawing 5]



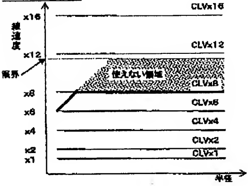
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]